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(54) **FLASHLIGHT HAVING A REMOVABLE LIGHT HEAD**

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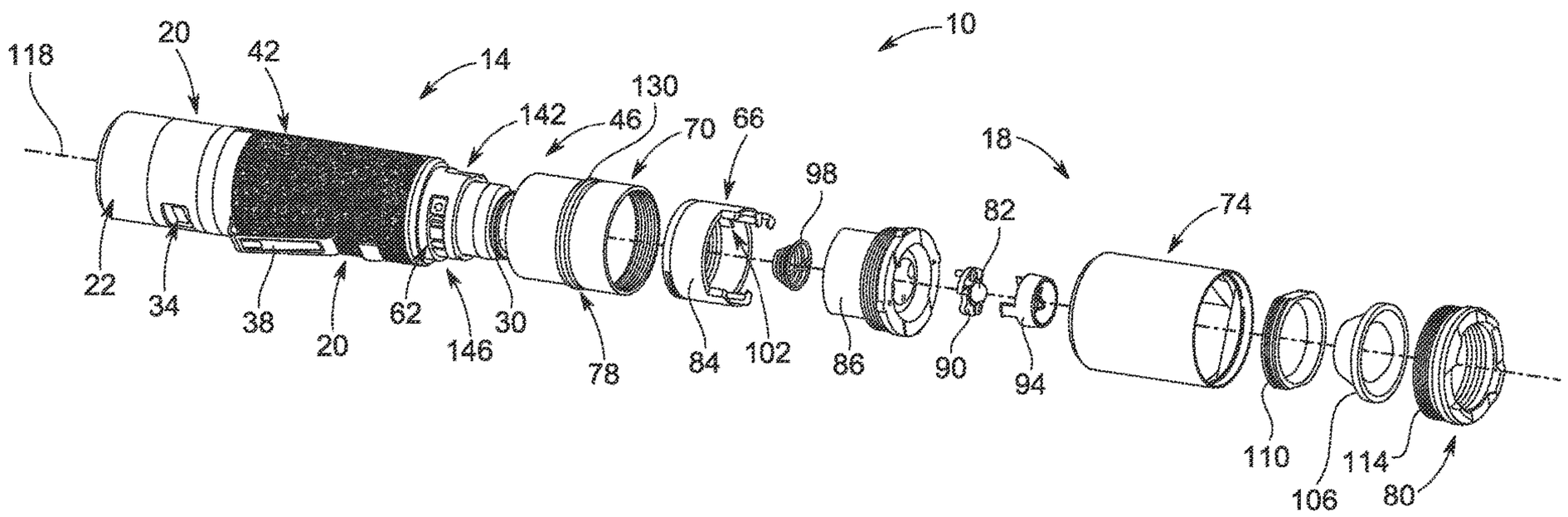
(57) **ABSTRACT**

A flashlight includes a main body, a power source supported within the main body, a first electrical contact supported by the main body and electrically connected to the power source, and a head removably coupled to the main body. The head includes a light source, a lens, and a sliding focus mechanism axially moveable to adjust a distance between the light source and the lens. The flashlight further includes a second electrical contact supported by the head and electrically connected to the light source, a main body bayonet portion supporting the first electrical contact, and a head bayonet portion supporting the second electrical contact and engaged with the main body bayonet portion to electrically connect the first electrical contact with the second electrical contact.

21 Claims, 7 Drawing Sheets



(51) **Int. Cl.**

F21V 31/00	(2006.01)
F21V 17/00	(2006.01)
F21V 17/14	(2006.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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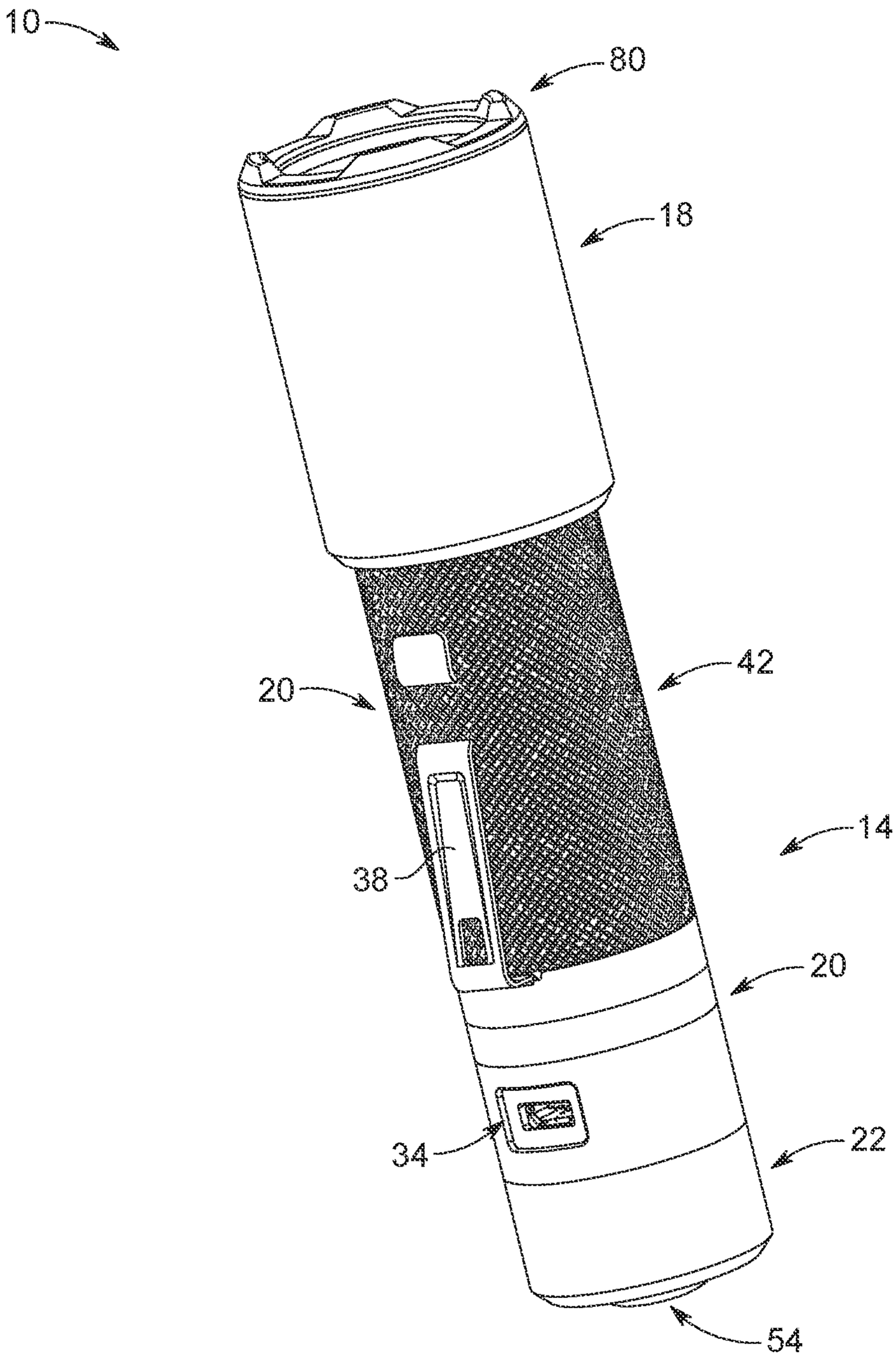


FIG. 1

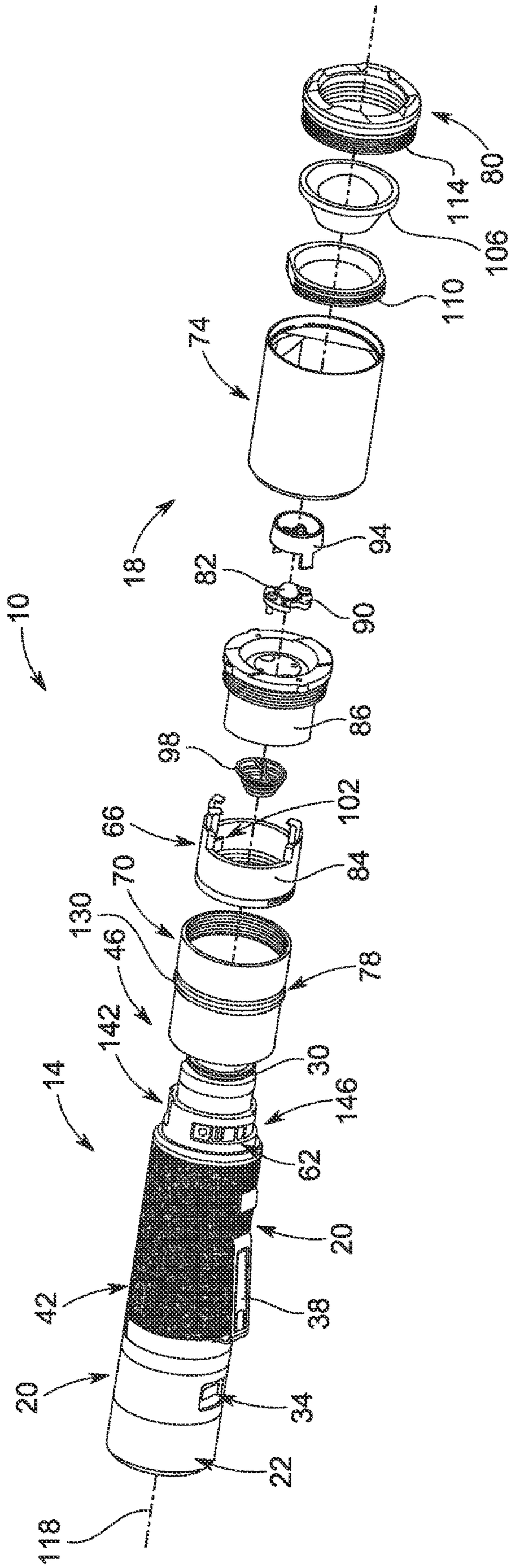
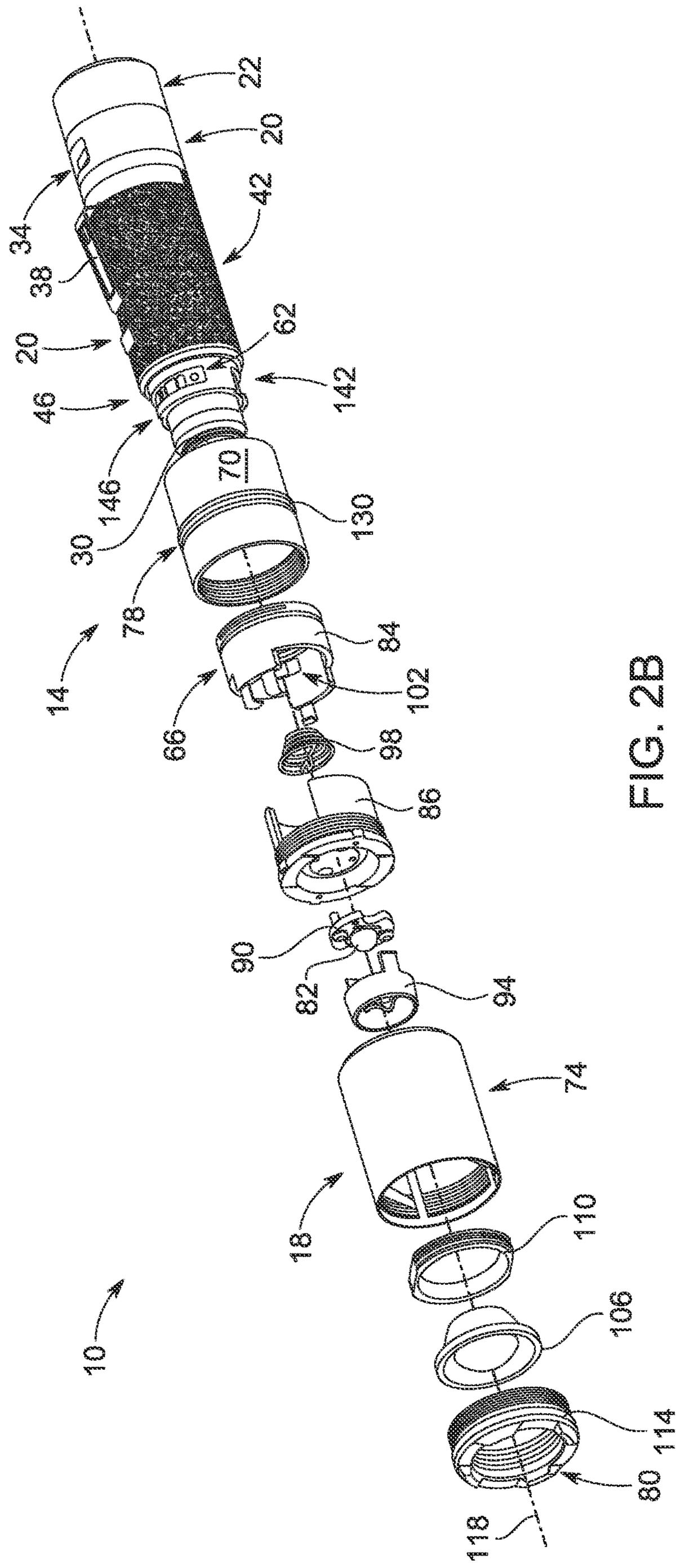

10
18
14
74
80
114
106
110
94
82
90
86
98
102
66
84
70
130
46
78
142
30
146
62
20
42
38
34
22
118

FIG. 2A


22
20
42
34
38
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62
142
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70
6
146
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130
78
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102
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90
82
94
74
18
110
106
114
80
118
10

FIG. 2B

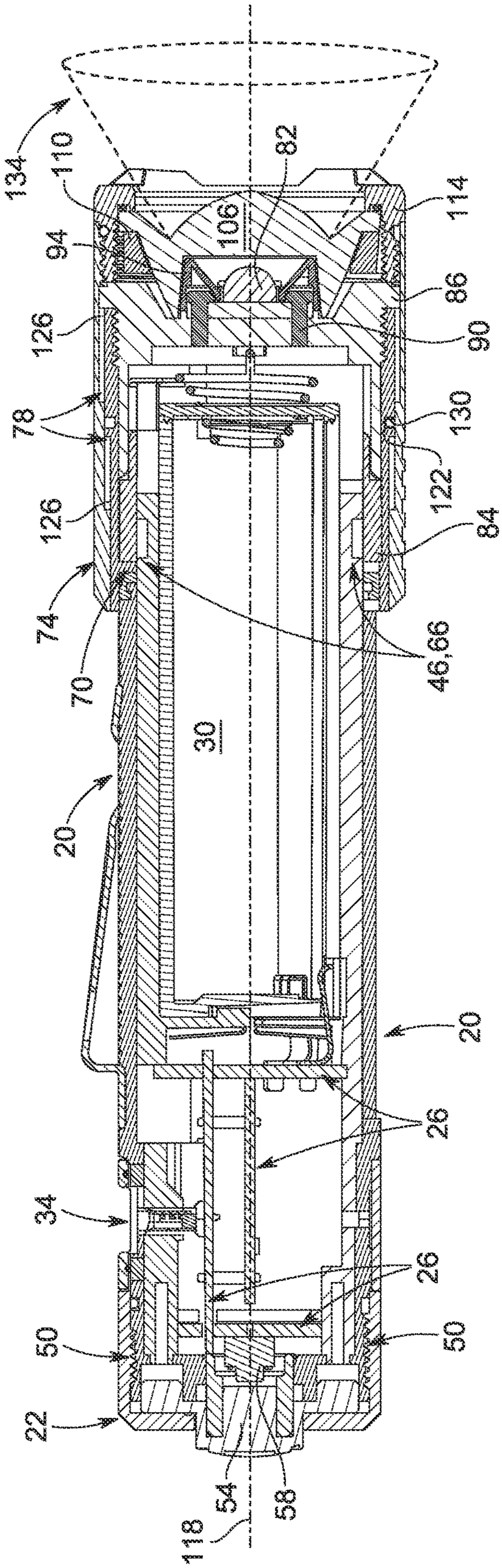
134
110
82
114
106
94
86
126
90
78
130
122
126
84
74
46,66
70
30
20
20
26
34
26
50
50
22
54
58
118

FIG. 3A

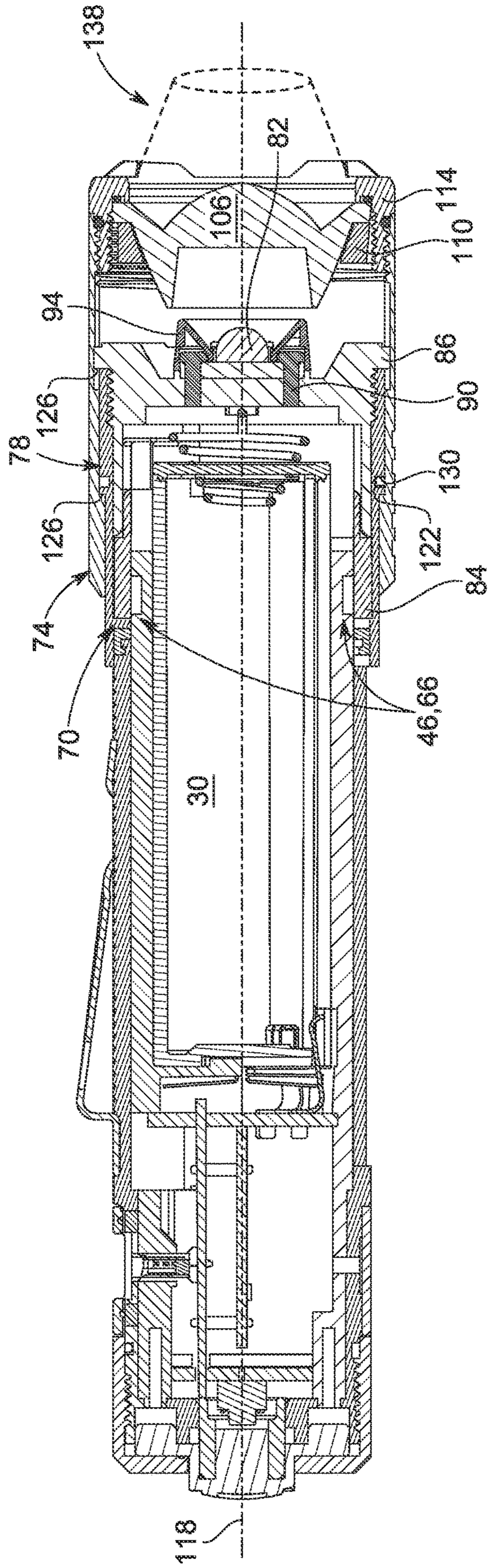

FIG. 3B

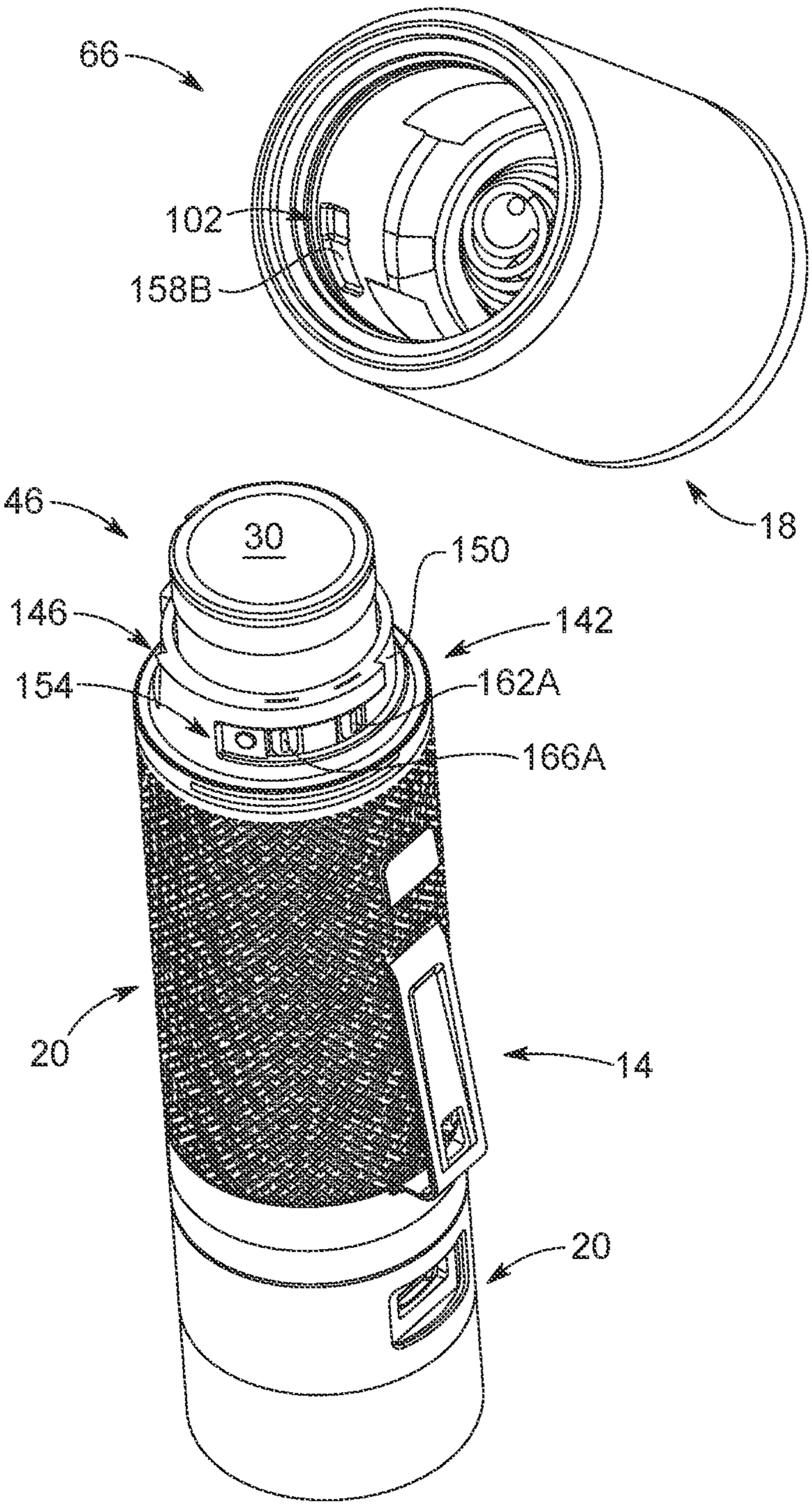

FIG. 4A

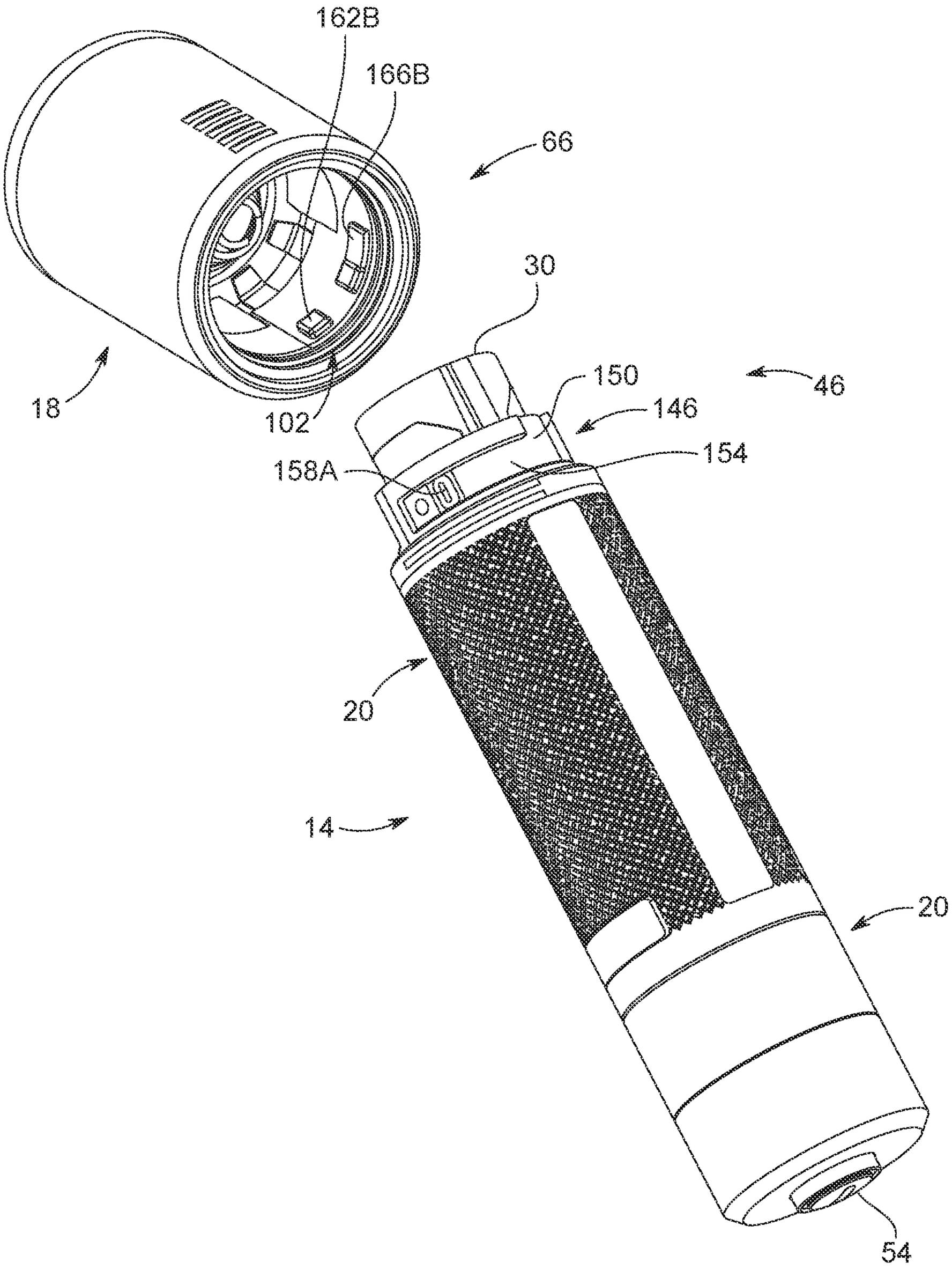

FIG. 4B

FLASHLIGHT HAVING A REMOVABLE LIGHT HEAD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application No. 63/133,820 filed Jan. 5, 2021, the entire contents of which are incorporated herein by reference.

FIELD

The present disclosure relates to a lighting apparatus, such as a flashlight. More particularly, the present disclosure relates to a flashlight with a removable light head.

BACKGROUND

Typical flashlight heads house at least one bulb or LED. Generally, the bulb/LED is irremovably attached to a power source, which is often stored in a main body or handle part of the flashlight.

SUMMARY

In one embodiment, the invention provides a flashlight including a main body, a power source supported within the main body, a light head removably coupled to the main body. The light head includes a light source selectively powered by the power source, a lens, and a sliding focus mechanism that is linearly slidable along an axial direction to adjust a distance between the light source and the lens. The light source is electrically connected with the power source while the light head is coupled to the main body.

In another embodiment, the invention provides a flashlight including a main body including a main body connection portion and an end cap, a power source supported within the main body between the end cap and the main body connection portion, a first electrical contact supported in the main body connection portion and electrically connected to the power source, a light head including a light source and a light head connection portion, and a second electrical contact supported in the light head connection portion and electrically connected to the light source. The light head is rotatable and axially slidable along an axial direction relative to the main body to selectively remove the light head from the main body and electrically disconnect the power source from the light source.

In yet another embodiment, the invention provides a flashlight including a main body, a power source supported within the main body, a first electrical contact supported by the main body and electrically connected to the power source, a head removably coupled to the main body, the head including a light source, a lens, and a sliding focus mechanism axially moveable to adjust a distance between the light source and the lens, a second electrical contact supported by the head and electrically connected to the light source, a main body bayonet portion supporting the first electrical contact, and a head bayonet portion supporting the second electrical contact and engaged with the main body bayonet portion to electrically connect the first electrical contact with the second electrical contact.

Other aspects of the disclosure will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a flashlight.

FIG. **2**A is an exploded view of the flashlight of FIG. **1**.

FIG. **2**B is another exploded view flashlight of FIG. **1**.

FIG. **3**A is a cross-sectional view of the flashlight taken along line **3-3** of FIG. **1** to show a sliding focus mechanism in a first position.

FIG. **3**B is a cross-sectional view of the flashlight taken along line **3-3** of FIG. **1** to show the sliding focus mechanism in a second position.

FIG. **4**A is a perspective view of the flashlight of FIG. **1** with a light head removed to show a connection portion.

FIG. **4**B is another perspective view of the flashlight of FIG. **1** with the light head removed to show the connection portion.

Before any embodiments of the disclosure are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The disclosure is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

Use of "including" and "comprising" and variations thereof as used herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Use of "consisting of" and variations thereof as used herein is meant to encompass only the items listed thereafter and equivalents thereof. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings.

DETAILED DESCRIPTION

As shown in FIGS. **1-2**B, a flashlight **10** includes a main body **14** and a light head **18** selectively attachable to the main body **14**. The main body **14** is configured to be grasped by a user and may also be referred to as a handle. The main body **14** includes a housing **20**, an end cap **22** coupled to a first end of the housing **20**, one or more circuit boards **26** (e.g., main control board (MCB), power control board (PCB), encoder board/chip, etc.) (FIG. **3**A) positioned within the housing **20**, and a power source **30** positioned within the housing **20**. In the illustrated embodiment, the power source **30** is a removable/rechargeable battery **30**. The illustrated main body **14** also includes a battery charging receptacle **34** and a clip **38** supported by the housing **20**. The housing **20** defines a grip **42**, such as a knurled or otherwise contoured surface. In the illustrated embodiment, the main body **14** further includes a main body portion **46** to selectively couple the light head **18** to the main body **14**.

With reference to FIGS. **2**A-**3**B, the end cap **22** is attached to the main body **14** via a threaded connection **50** between the end cap **22** and the main body **14**. In other embodiments, the end cap **22** may be attached to the main body **14** by another attachment mechanisms such as a fastener. In yet another embodiment, the end cap **22** may be integrally formed on the main body **14**. As best shown in FIGS. **3**A and **3**B, the end cap **22** supports a physical switch **54**. In the illustrated embodiment, the switch **54** is a push-button. In other embodiments, the switch **54** could alternatively be a pressure pad, a rotatable selector switch, a toggle, a slider, or the like. In some embodiments, the switch **54** may be located elsewhere on the main body **14** or may be located on the light head **18**.

The switch **54** is moveable (e.g., depressible) by a user to control operation of the flashlight **10** (e.g., ON/OFF). In some embodiments, the switch **54** may also control a mode (e.g., high, medium, low, flashing, etc.) of the flashlight **10**. A switch contact **58** is supported within the main body **14** adjacent the switch **54**. The switch contact **58** is in electrical communication with at least one of the circuit boards **26**. The switch contact **58** is configured to read a condition of the switch **54** and communicate the read condition to one of the boards **26**. Although the switch **54** and the circuit boards **26** are adjacent one another in the illustrated embodiment, the switch **54** and the circuit boards **26** could be positioned in different locations on or in the flashlight **10**, main body **14**, and/or end cap **22**.

The circuit boards **26** are also utilized to control charging of the battery **30** through the battery charging receptacle **34**. The battery charging receptacle **34** may be configured to receive a connector (e.g., USB, micro USB, USB-C, etc.) suitable for supplying power to the battery **30**, which in turn supplies power to the flashlight **10**. In other embodiments, the battery **30** is a removable and disposable battery **30**. In general, electrical components (e.g., the switch contact **58**, the charging receptacle **34**, etc.) supported on or in the main body **14** are always in electrical communication with the boards **26** and battery **30**. The battery **30** also supplies power to electrical contacts **62** of the main body connection portion **46**.

With continued reference to FIGS. **2**A-**3**A, the light head **18** includes a head connection portion **66**, a base **70**, a focusing head **74**, and a sliding mechanism **78**. The illustrated light head **18** may also include one or more projections **80** that extend from the light head **18**. As will be described in greater detail below with reference to FIGS. **4**A and **4**B, the main body connection portion **46** and head connection portion **66** are complementary to one another and are configured to selectively electrically and mechanically connect the light head **18** to the main body **14**.

With specific reference to FIGS. **2**A and **2**B, the light head **18** houses a light source **82** supported within the base **70** on a support **90** and configured to generate light. In the illustrated embodiment, the light source **82** is a light emitting diode (LED). In some embodiments, the light source **82** may include an array of LEDs. In other embodiments, the light head **18** may include other suitable light sources. In the illustrated embodiment, the base **70** further includes a conductive substrate **84** and an insert **86**. The substrate **84** and insert **86** are fastened within the base **70**. In other embodiments, either or both of the substrate **84** and the insert **86** may be formed on the base **70**. The base **70** further supports a reflector cup or bowl **94** surrounding the light source **82**, a retainer **98**, and electrical contacts **102** positioned within the head connection portion **66** (FIGS. **4**A and **4**B). The retainer **98**, which may be referred to as a spring retainer or a spring, is positioned on the base **70** and asserts a spring force onto the battery **30** while the light head **18** and the main body **14** are connected together. In other embodiments, the spring **98** could be positioned on the main body **14**, directly supported on the battery **30**, bearing against the battery **30**, or disposed on another part of the flashlight **10** in order to maintain a tight fit between the light head **18** and the main housing **14** when connected. In still other embodiments, the spring **98** could be a rigid member for maintaining a tight fit between the connected light head **18** and the main housing **14**.

The focusing head **74** includes a lens **106** supported in the focusing head **74** by a lens mount **110** and a lens retainer **114**. The lens mount **110** is threaded into the focusing head **74** on one end of the lens **106**. The lens retainer **114** is threaded into the focusing head **74** on another end of the lens **106**, opposite the lens mount **110**, such that the lens **106** is retained within the focusing head **74** between the mount **110** and the retainer **114**. The arrangement of the mount **110** and the retainer **114** eliminates the need to form threads directly on the lens **106**. In another embodiment, the lens **106** may be formed on the focusing head **74** or even over molded within the focusing head **74**. The projections **80** may be formed on or attached to the focusing head **74** to protect the lens **106**. Heat generated during operation of the flashlight **10** may also be dissipated into the projections **80** to reduce an operating temperature within the flashlight **10**.

Referring now to FIGS. **3**A and **3**B, the focusing head **74** is moveable relative to the base **70** via the sliding mechanism **78** to alter a distance between the LED **82** and the lens **106**. In the illustrated embodiment, the focusing head **74** linearly slides in an axial direction **118** that is parallel to a longitudinal axis of the flashlight **10**. The sliding mechanism **78** includes a groove **122** formed in the base **70** and stops **126** formed on the focusing head **74** and the base **70**. The groove **122** is configured to receive a gasket **130** (e.g., an O-ring, an X-ring, etc.) positioned between the focusing head **74** and the base **70**. In the illustrated embodiment, the gasket **130** is positioned in the groove **122** formed on an outer surface of the base **70**. In another embodiment, the groove **122** is formed on an inner surface of the focusing head **74**.

The gasket **130** applies resistance between the focusing head **74** and the base **70** to resist movement between the focusing head **74** and the base **70**. Enough resistance is applied by the gasket **130** to allow a user to move (e.g., linearly slide) the focusing head **74** to a desired position. The focusing head **74** and the base **70** are shaped such that the stops **126** limit the movement of the focusing head **74** relative to the base **70**. The stops **126** allow the focusing head **74** to be moved between a first position (FIG. **3**A) and second position (FIG. **3**B).

In the first position, the focusing head **74** is at a minimum limit, and light emitted by the light source **82** shines through the lens **106** with a relatively wide pattern **134**. In the second position, the focusing head **74** is at a maximum limit, and light emitted by the light source **82** shines through the lens **106** with a relatively narrow or spotlight pattern **138**. Stated another way, an area of light emitted by the light source **82** narrows as the lens **106** is moved away from the light source **82**. While the stops **126** inhibit the focusing head **74** from moving beyond the maximum and minimum limit, the gasket **130** allows the focusing head **74** to moved smoothly between the limits.

Referring now to FIGS. **4**A and **4**B, the complementary main body and head connection portions **46**, **66** will be described in greater detail. The illustrated connection portions **46**, **66** form a bayonet-style connection between the main body **14** and the light head **18**. As such, the main body connection portion **46** may be referred to as a main body bayonet portion **46**, and the head connection portion **66** may be referred to as a head bayonet portion **66**. The connection portions **46**, **66** allow the light head **18** to be disconnected and physically separated from the main body **14** without tools or otherwise disassembling the flashlight **10**. Separating the light head **18** from the main body **14** allows a user to access and remove or replace the battery **30** such that battery **30** may be accessible in the main body **14** while the light head **18** is separated from the main body **14**.

The illustrated main body connection portion **46** includes a first bayonet channel **142** and a second bayonet channel

146. Each of the first and second bayonet channels **142**, **146** have a linear groove **150** and a radial groove **154** continuous with the linear groove **150**. The linear groove **150** is an axial groove that that extends in the axial direction **118**, while the radial groove **154** extends radially around a portion of the handle housing **14**. The radial groove **154** supports the electrical contacts **62**, which may consist of a first positive terminal **158**A (e.g., LED+), a first negative terminal **162**A (e.g., LED−), and a first auxiliary terminal **166**A (e.g., ground, negative-temperature-coefficient thermistor, etc.).

The illustrated head connection portion **66** includes the electrical contacts **102**, which consist of a second positive terminal **158**B (e.g., LED+), a second negative terminal **162**B (e.g., LED−), and a second auxiliary terminal **166**B (e.g., ground, negative-temperature-coefficient thermistor, etc.). In the illustrated embodiment, the head connection portion **66** and the terminals **158**B, **162**B, **166**B are supported on the substrate **84**. The illustrated terminals **158**B, **162**B, **166**B are conductor pads that project radially inward from the substrate **84**. The substrate **84** is configured to electrically connect the terminals **158**B, **162**B, **166**B to the light source **82**. In other embodiments, the head connection portion **66** and terminals **158**B, **162**B, **166**B may be provided on another part of the base **70**.

As illustrated in the FIGS. **4**A and **4**B, the second positive terminal **158**B is arranged to be received in one of the first and second bayonet channels **142**, **146**, while the second negative terminal **162**B is arranged to be received in the other of the first and second bayonet channels **142**, **146**. In other embodiments, the second positive terminal **158**B, the second negative terminal **162**B, and the second auxiliary terminal **166**B may be arranged in the same channel. In yet another embodiment, the terminals **158**B, **162**B, **166**B may be arranged in any arraignment or combination within the channels **142**, **146**.

The electrical contacts **102** are configured to be physically received in the bayonet channels **142**, **146** and to electrically interface with the electrical contacts **62**. More specially, the electrical contacts **102** are initially received in the linear groove **150** and do not make electrical connection with the electrical contacts **62**. Following adequate axial movement, the electrical contacts **102** are moved radially within the radial groove **154** into electrical connection with the electrical contacts **62**. Concurrently, the electrical contacts **102** are moved into mechanical connection with the electrical contacts **62** through a snap fit. Stated another way, the electrical contacts **102** may be moved over the electrical contacts **62** by overcoming (e.g., temporarily overcoming) an outward biasing or snapping force to retain the LED head **18** on the handle housing **14**.

As described above, the battery **30** supplies power to the electrical contacts **62** within the main body connection portion **46**. When the light head **18**, or another electrically powered device or head, is sufficiently moved axially and radially to be attached to the main body **14**, electrical contacts **102** on the light head **18** are moved into contact with the electrical contacts **62** on the main body **14** to complete an electrical circuit from the battery **30**, thereby powering the light head **18**. For example, a power circuit between the battery **30**, the electrical contacts **62** on the main body **14**, the electrical contacts **102** on the light head **18**, and the light source **82** is completed after sufficient axial and radial movement of the light head **18** relative the main body **14**.

Described another way, the flashlight **10** includes the main body **14**, the light head **18**, and a bayonet mount mechanism including complimentary male and female parts (i.e., bayonet portions **46**, **66**). Either of the male and female portions include conductors (i.e., contacts **62** and pads **102**) configured to electrically interface with one another to selectively power the light head **18** and mechanically couple the main body **14** and the light head **18** to one another. In the illustrated embodiment, the light head **18** includes the male bayonet portion in the form of the head connection portion **66** and the electrical contacts **102**, while the main body **14** includes the female bayonet portion in the form of the main body connection portion **46**, the channels **142**, **146**, and the electrical contacts **62**. In other embodiments, the male and female portions are provided on different parts of the flashlight **10** such that the present invention is not limited to the male and female arrangement described above. For example, in another embodiment, the main body **14** includes the male portion and the electrical contacts **102**, while the light head **18** includes the female portion and the electrical contacts **62**.

In operation of the flashlight **10**, while electricity is being carried through the electrical contacts **62** and the electrical contacts **102**, a user may operate the switch **54** to selectively control a state of the light source **82** (e.g., ON/OFF). In the ON state of the light source **82**, a full circuit, which includes the circuit boards **26**, the battery **30**, the switch contacts **58**, the electrical contacts **62**, the light source **82**, the substrate **84**, and/or the electrical contacts **102**, is completed and the light source **82** is powered by a PWM signal to emit a pattern or area of light.

In the OFF state of the light source **82**, the full circuit described above is still completed, but no PWM signal is sent to power the light source **82**. While in either the ON or OFF state, the user may selectively break the full circuit by rotating the light head **18** relative the main body **14** a sufficient amount to disconnect the electrical contacts **62** from the electrical contacts **102**. The user may further move the light head **18** axially relative the main body **14** to completely remove the light head **18** from the main body **14**.

In order to re-complete the full circuit, the user may axially insert the electrical contacts **102** into the bayonet channels **142**, **146** and rotate the light head **18** relative the main body **14** to connect the electrical contacts **102** with the electrical contacts **62**. In this manner, the user effectively re-connects the light head **18** to the main body **14**.

The embodiment(s) described above and illustrated in the figures are presented by way of example only and are not intended as a limitation upon the concepts and principles of the present disclosure. As such, it will be appreciated that variations and modifications to the elements and their configuration and/or arrangement exist within the spirit and scope of one or more independent aspects as described.

What is claimed is:

1. A flashlight comprising:

a main body;

a power source supported within the main body; and

a light head removably coupled to the main body, the light head including

a light source selectively powered by the power source,

a lens, and

a sliding focus mechanism that is linearly slidable along an axial direction to adjust a distance between the light source and the lens,

wherein the light source is electrically connected with the power source while the light head is coupled to the main body,

wherein the light head is removably coupled to the main body by a bayonet-style connection, and wherein a first connection portion of the bayonet-style connection is formed on the light head and a second connection

portion complementary to the first connection portion is formed on the main body, and

wherein the first and second connection portions each include electrical contacts configured to electrically connect the power source and the light source.

2. The flashlight of claim **1**, wherein a portion of the light head other than the first connection portion selectively bears against the power source while the light head is coupled to the main body, and wherein the power source is accessible in the main body while the light head is separated from the main body.

3. The flashlight of claim **1**, wherein the light head further includes

a base including a light source support, and

a focusing head portion moveable relative the base via the sliding focus mechanism, the sliding focus mechanism having stops limiting axial relative movement between the base and the focusing head portion.

4. The flashlight of claim **3**, wherein the light head further includes a gasket positioned between the focusing head and the base to resist movement therebetween.

5. The flashlight of claim **3**, wherein the focusing head portion includes a lens mount and a lens retainer threadably coupled to the focusing head portion on opposing ends of the lens such that the lens is retained within the focusing head portion between the lens mount and the lens retainer.

6. The flashlight of claim **5**, wherein the base further includes

a substrate,

an insert, the insert and the substrate each threadably fastened within the base, one or more of the substrate and the insert being electrically conductive, and

a reflector surrounding the light source.

7. The flashlight of claim **6**, wherein the lens, the lens mount, and the lens retainer are axially moveable via the sliding mechanism relative the substrate, the insert, the light source, and the reflector between the stops to selectively generate a relatively wide or narrow light pattern, the lens surrounding the reflector and the light source to generate the relatively wide light pattern.

8. A flashlight comprising:

a main body including a main body connection portion and an end cap;

a power source supported within the main body between the end cap and the main body connection portion;

a first electrical contact supported in the main body connection portion and electrically connected to the power source;

a light head including a light source and a light head connection portion; and

a second electrical contact supported in the light head connection portion and electrically connected to the light source, the light head being rotatable and axially slidable along an axial direction relative to the main body to selectively remove the light head from the main body and electrically disconnect the power source from the light source.

9. The flashlight of claim **8**, wherein the main body connection portion includes a bayonet channel, and wherein the first electrical contact is positioned within the bayonet channel.

10. The flashlight of claim **9**, wherein the second electrical contact is slidably received in the bayonet channel and rotatable with the light head into connection with the first electrical contact.

11. The flashlight of claim **10**, wherein the bayonet channel includes a linear groove portion and a radial groove portion continuous with the linear groove portion, the linear groove portion extending axially along the axial direction and the radial groove portion extending from the linear groove portion and radially around a portion of the main body.

12. The flashlight of claim **11**, wherein the first electrical contact is positioned within the radial groove portion of the bayonet channel.

13. The flashlight of claim **12**, wherein the second electrical contact connects to the first electrical contact only in the radial groove portion.

14. The flashlight of claim **10**, wherein the first electrical contact generates a biasing force radially outwardly, and wherein the second electrical contact is rotatable relative the first electrical contact to temporarily overcome the biasing force and snap the second electrical contact into electrical and mechanical connection with the first electrical contact.

15. A flashlight comprising:

a main body;

a power source supported within the main body;

a first electrical contact supported by the main body and electrically connected to the power source;

a head removably coupled to the main body, the head including a light source, a lens, and a sliding focus mechanism axially moveable to adjust a distance between the light source and the lens;

a second electrical contact supported by the head and electrically connected to the light source;

a main body bayonet portion supporting the first electrical contact; and

a head bayonet portion supporting the second electrical contact and engaged with the main body bayonet portion to electrically connect the first electrical contact with the second electrical contact.

16. The flashlight of claim **15**, wherein the main body bayonet portion includes a bayonet channel, and wherein the first electrical contact is positioned within the bayonet channel.

17. The flashlight of claim **16**, wherein the bayonet channel is first bayonet channel positioned on a first side of the main body, and wherein the main body bayonet portion includes a second bayonet channel positioned on a second side of the main body opposite the first side.

18. The flashlight of claim **17**, further comprising

a third electrical contact supported by the main body and electrically connected to the power source; and

a fourth electrical contact supported by the head and electrically connected to the light source,

wherein the second bayonet channel includes the third electrical contact, and

wherein the head is rotatable relative the main body to electrically connect the first electrical contact with the second electrical contact in the first bayonet channel and to electrically connect the third electrical contact with the fourth electrical contact in the second bayonet channel.

19. A flashlight comprising:

a main body;

a power source supported within the main body; and

a light head removably coupled to the main body, the light head including

a light source selectively powered by the power source,

a lens, and

a sliding focus mechanism that is linearly slidable along an axial direction to adjust a distance between the light source and the lens,

wherein the light source is electrically connected with the power source while the light head is coupled to the main body,

wherein the light head further includes

a base including a light source support, and

a focusing head portion moveable relative the base via the sliding focus mechanism, the sliding focus mechanism having stops limiting axial relative movement

between the base and the focusing head portion, and

wherein the focusing head portion includes a lens mount and a lens retainer threadably coupled to the focusing head portion on opposing ends of the lens such that the lens is retained within the focusing head portion between the lens mount and the lens retainer.

20. The flashlight of claim **19**, wherein the base further includes

a substrate,

an insert, the insert and the substrate each threadably fastened within the base, one or more of the substrate and the insert being electrically conductive, and

a reflector surrounding the light source.

21. The flashlight of claim **20**, wherein the lens, the lens mount, and the lens retainer are axially moveable via the sliding mechanism relative the substrate, the insert, the light source, and the reflector between the stops to selectively generate a relatively wide or narrow light pattern, the lens surrounding the reflector and the light source to generate the relatively wide light pattern.

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